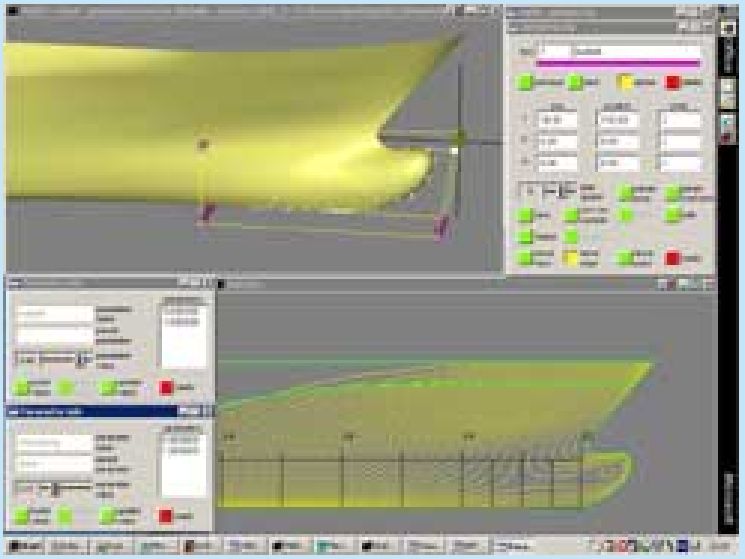
CFD-based optimisation process improves dramatically

Optimisation of a hull form to get the best hydrodynamic performance is at the heart of ship design. Capabilities in this area have recently improved by the introduction of parametric hull form deformation and automated parallel processing of the RAPID code.



Example of specification of parameters.

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Owing to the increasing capability and reliability of CFD-based, performance analysis of ships, quality assessment by CFD analysis in the early design stage has become an accepted instrument. However, the underlying processes are time-consuming, which in practice limits the number of variants that a designer can handle. Under the EU-funded project FANTASTIC, MARIN has now made a drastic improvement in two areas - geometry handling and automation.

Parametric hull form deformation

Like most other CAD systems, MARIN's GMS-package is based on a digital surface representation of the hull geometry. To ease the task of creating new design variants, we have introduced the technique of "volume deformation". A box-like region is defined around those parts of the hull where modification is admissible and potentially beneficial. Selected deformations of this box are carried over to the hull part inside the box. By associating a number with the amount of deformation a whole family of hull shapes is obtained (parametric shape variation). MARIN has chosen to accept an initial hull form of any shape and to parameterise its modifications, rather than to establish a parametric model of the complete hull. The definition of the modifications is left to the designer, who can exploit his experience and imagination and make sure that the modifications are relevant for the case at hand. In an interactive session of an hour or so, a multi-parameter hull form family can be defined.

Automated parallel processing

For a set of members of this hull form family, the non-linear free surface panel code, RAPID is run. Once a panel distribution has been defined for the initial hull, similar distributions are automatically generated for the others. The computations are executed in parallel on a multi-processor machine, so that in the same time that 3 to 6 variants could be analysed previously, now hundreds of cases can be investigated. The predicted wave patterns, wave resistance, pressure distributions and their dependence on the design parameters are then visualised. This gives a clear insight in trends and improves the effectiveness of the optimisation process.

The new system for defining and evaluating systematic hull form variations is now used extensively in practical projects at MARIN.

More information and results of applications can be found in: "A practical approach to constrained hydrodynamic optimisation of ships", M. Hoekstra, H.C.Raven, NAV 2003 Symposium, Palermo (see www.marin.nl).

GMS/Facet - a variety of bulbous bow shapes, defined by different single-parameter deformations to an original shape.